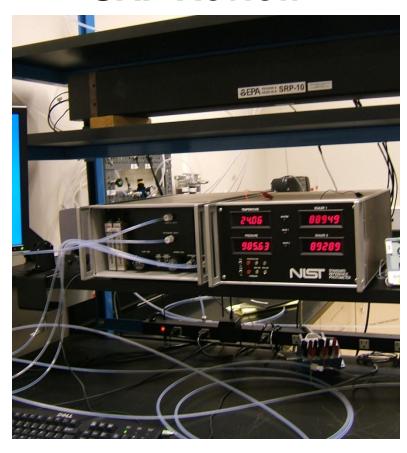


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### SRP Review



**Mike Crowe** 

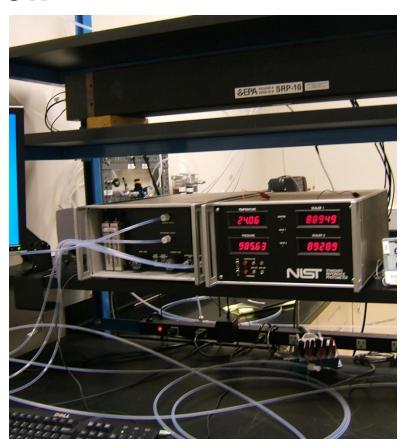
USEPA Region 4
Science and Ecosystem Support Division



Tampa, Florida - 2011

### SRP Review

Question: What year did the SRP come to Athens?





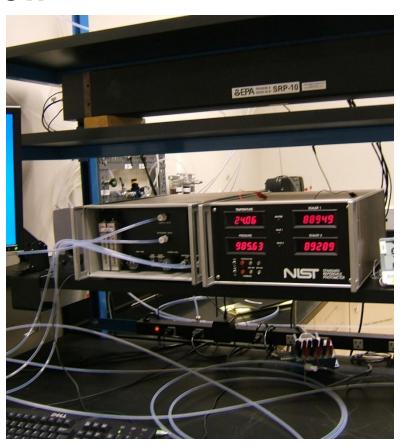
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### SRP Review

Question: What year did the SRP come to Athens?

**Answer:** 

It came to Athens in 1987.



24 years ago!



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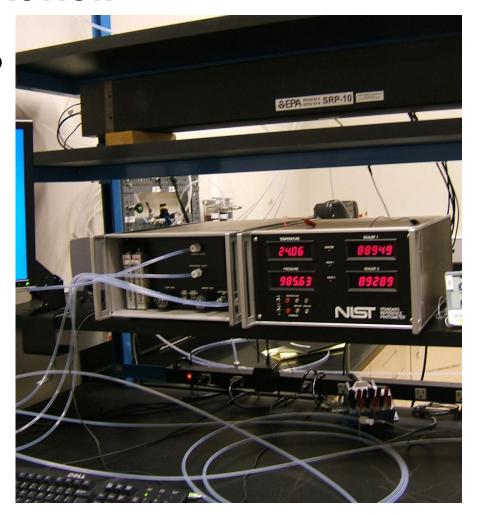
### SRP Review

Question: What is it?

S

R

P





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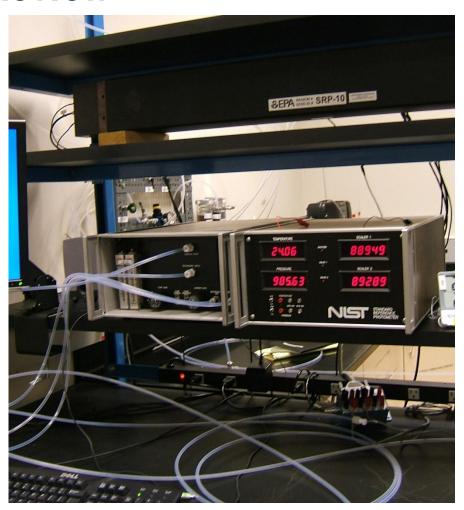
### SRP Review

Question: What is it?

**Standard** 

Reference

**Photometer** 





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### Background

Because of the instability of ozone  $(O_3)$ , the certification of  $O_3$  concentrations as Standard Reference Materials (SRMs) is impractical, if not impossible. Thus, when  $O_3$  concentration standards are required, they must be generated and certified locally.





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### Background

Because of the instability of ozone  $(O_3)$ , the certification of  $O_3$  concentrations as Standard Reference Materials (SRMs) is impractical, if not impossible. Thus, when  $O_3$  concentration standards are required, they must be generated and certified locally.



You can't have a tank of ozone.



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### Background





- The SRP Program started in the early 1980s.
- The SRP Program is part of the National Performance Evaluation Program.



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**Optical Bench** 

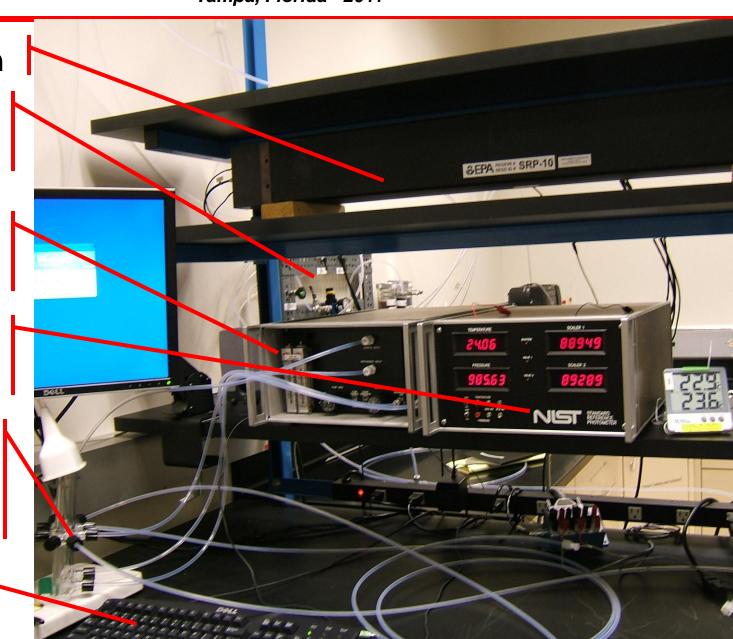
Zero Air System

Pneumatics Module

**Electronics Module** 

Sample and Reference Manifolds

PC





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### Steps for verification of Level 2 transfer standard:

- 1) Perform QC checks on SRP
- 2) Configure plumbing for guest instrument.
- 3) Turn on guest instrument for warm up.
- 4) Configure guest instrument communication.
- 5) Run a few informal upscale concentrations (ozone conditioning).
- 6) Formal verification.

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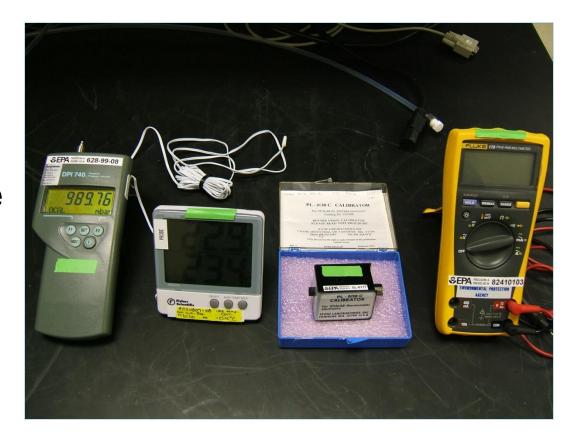


- Pressure must be accurate ± 0.2 mb.
- Temperature must be accurate ± 0.1°C
- Stability: SD must be ≤ 0.7
- There are no ozone coefficients that can be adjusted on an SRP.
- It can take up to 3 hours to perform QC check.



## New at SESD in Athens...

- ISO 17025 accreditation.
- All instruments that are used to verify the accuracy of the SRP are part of SESD's quality system, and are NIST traceable.





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# Guest plumbing

Zero Air (Reference)

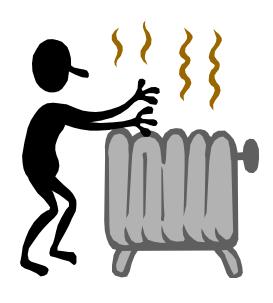


Sample

**SRP Manifold** 



# Turn on Guest for warm up.



• ≥ 1 hour

 Includes 30 minutes ozone pre-conditioning



# Configure communication.

Three ways to get Guest instrument data into the SRP Control program.

- 1. Front Panel
- 2. Analog Outputs
  - 3. Serial Port



# Configure communication.

## Front panel

The front panel display is the "common denominator" for all users of the guest instrument. So, the goal is to collect data, that agrees with the front panel. But, nobody wants to have to manually enter an ozone value, EVERY 30 SECONDS for 3

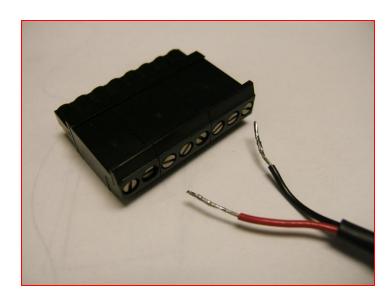






# Configure communication.

- Analog Output
- This is a good way to collect data automatically.
- Most instruments are capable.
- The SRP Control Program may have to be "calibrated" to the analog outputs from the guest instrument.



Configure Connection
Analog Channel# 井1 Volts 井10
Conversion Slope 100
Conversion Intercept 0

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# Configure communication.

- Serial Port
- This is BEST
- There are drivers available for most commercial instruments
- It typically agrees perfectly with the front panel

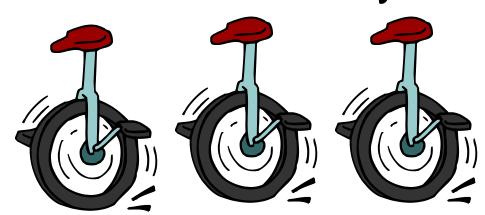


- Configure Connectio	on
Comm Port#	<del>-</del> 1
Baud Rate	9600 🔻
Bits,Parity,Stop	-8 n ▼1 ▼
Inst Driver File	TECO49C.drv
Instrument ID: (ASCI	code = \#)   \187
Password 940331	03 Generator 🗆



## **Annual Verification Minimum Requirements**

## A minimum of 3 cycles



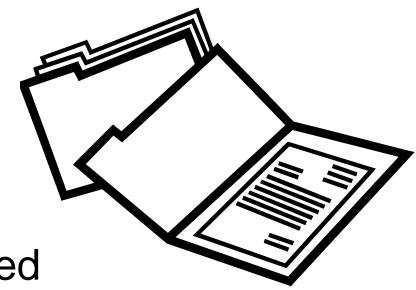
## 1 cycle =

- 6 upscale concentrations and one zero point.
- 7 replicate measurements of each point.
- Each cycle last about one hour.



# What you get...

- Individual "calibration reports" (one for each cycle)
- Summary Report
- Official paperwork is mailed to you





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### Standard Reference Photometer Calibration Report

Calibrating Institute: EPA Region 4

Operator: Mike Crowe Instrument: SRP-10

Comment:

SRP-10 Cell Length=89.84

Date: 14 Start Time: 16

14-Feb-11 16:46 17:51

End Time: 17:51 Filename: c0214001.xls

Calibrated Instrument:	49CPS	Calibration		Standard
Owner:	R4ESAT	Results	Value	Uncertainty
Contact:	Jason Brown	Slope	1.00058	0.00041
Make:	TEI	Intercept	-0.49240	0.07039
Model:	49C Calibrator	Covariance		-4.2756E-08
Serial Number:	49CPS-72422-371	Res Std Dev	0.15835	

Calibration Parameters: Zero Start&End;Raw Saved;Dark Count On (7)

Air Flow Rate: 6.0 I/min

Lamp Intensity Range: 0.0 to 40.0 %

Number Conc. Points: 8 Points/Concentration: 7

Conditioning: none

Containering.							
Calibration	SRI	P-10	490	CPS	49CPS		
Data Points	Result	Std. Dev	Result	Std. Dev	Predicted	Residual	
Dark Count 1	13						
Dark Count 2	9						
1	0.2	0.4	-0.3	0.1	-0.32	0.01	
2	464.5	0.1	464.2	0.1	464.27	-0.03	
3	94.3	0.4	94.1	0.2	93.82	0.27	
4	68.1	0.2	67.4	0.1	67.63	-0.23	
5	41.1	0.2	40.8	0.1	40.64	0.18	
6	18.1	0.2	17.5	0.1	17.59	-0.07	
7	9.8	0.3	9.3	0.1	9.35	-0.04	
8	0.3	0.2	-0.2	0.1	-0.16	-0.09	



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#### Ozone Transfer Standard Verification Summary Report



U. S. Environmental Protection Agency
Region 4 Science and Ecosystem Support Division
Enforcement and Investigations Branch
Superfund and Air Section
980 College Station Rd.
Athens, GA 30605

EPA GUEST Standard Instrument

Agency: EPA Region 4 R4ESAT Contact: Mike Crowe Jason Brown

Make: NIST TEI Model: SRP-10 49CPS

S/N: 10 49CPS-72422-371

 SESD Project #:
 11-0257
 Guest Test Status:
 PASS

 Test #:
 1
 Guest Known Offset:
 0

Level 2	Slope	Intercept	R <sup>2</sup>	High O <sub>3</sub>	Lower O <sub>3</sub>
Averages:	1.0035	-0.4816	0.9999989	467	0
Upper Tolerance:	1.0300	3.0000			
LowerTolerance:	0.9700	-3.0000			

								opper	Lower	
Date	Time	Date	Time					Range	Range	
Start	Start	End	End	File	Slope	Intercept	R <sup>2</sup>	(ppb O <sub>3</sub> )	(ppb O <sub>3</sub> )	
02/14/11	4:46 PM	02/14/11	5:51 PM	c0214001.xls	1.0006	-0.4924	0.9999990	464	0.17	
02/14/11	5:51 PM	02/14/11	6:57 PM	c0214002.xls	1.0035	-0.4975	0.9999989	466	0.09	
02/14/11	6:57 PM	02/14/11	8:01 PM	c0214003.xls	1.0028	-0.4950	0.9999986	468	0.12	
02/14/11	8:01 PM	02/14/11	9:06 PM	c0214004.xls	1.0045	-0.6201	0.9999997	467	0.28	
02/14/11	9:06 PM	02/14/11	10:11 PM	c0214005.xls	1.0044	-0.3930	0.9999997	468	-0.01	
02/14/11	10:11 PM	02/14/11	11:16 PM	c0214006.xls	1.0044	-0.4600	0.9999979	468	-0.02	
02/14/11	11:16 PM	02/15/11	12:22 AM	c0214007.xls	1.0045	-0.4134	0.9999984	468	0.06	

Comments: Instrument within tolerance.

No adjustments made.

Ozone calibration factors at time of test: Background = 0.2 Slope =1.012

Verification Expires on: February 14, 2012

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# What is a passing verification?

AL PROTECT

- Average slope of 0.97 to 1.03.
- Average intercept of ± 3 ppb.

GUEST **EPA** Standard Instrument Agency: EPA Region 4 R4ESAT Contact: Mike Crowe Jason Brown Make: NIST Model: **SRP-10** 49CPS S/N: 10 49CPS-72422-371 SESD Project #: 11-0257 Guest Test Status: PASS Test #: Guest Known Offset:

Athens, GA 30605

Slope

1.0035

1.0300

0.9700

Intercept

-0.4816

3.0000

-3.0000

0.99999

•	Stability	v: Sl	D≤	2.0
	Otabilit	y . 🔾		<b>L</b> . <b>U</b>

Date	Time	Date	Time				
Start	Start	End	End	File	Slope	Intercept	R <sup>2</sup>
02/14/11	4:46 PM	02/14/11	5:51 PM	c0214001.xls	1.0006	-0.4924	0.99999
02/14/11	5:51 PM	02/14/11	6:57 PM	c0214002.xls	1.0035	-0.4975	0.99999
02/14/11	6:57 PM	02/14/11	8:01 PM	c0214003.xls	1.0028	-0.4950	0.99999
02/14/11	8:01 PM	02/14/11	9:06 PM	c0214004.xls	1.0045	-0.6201	0.999999
02/14/11	9:06 PM	02/14/11	10:11 PM	c0214005.xls	1.0044	-0.3930	0.999999
02/14/11	10:11 PM	02/14/11	11:16 PM	c0214006.xls	1.0044	-0.4600	0.99999
02/14/11	11:16 PM	02/15/11	12:22 AM	c0214007.xls	1.0045	-0.4134	0.99999

Averages: Upper Tolerance:

\_owerTolerance:

Comments:

Instrument within tolerance.
No adjustments made.



## Recent observations

- Some organization are converting analyzers into standards: Slight re-plumbing is necessary
- Removal filter / ozone scrubber on reference side, and plumbed to the rear bulk-head.
- 2. The level 2 transfer standard must use the same zero air as the SRP during verification.





## Recent observations

 Some organization are converting analyzers into primary standards: Slight re-plumbing is necessary

3. Ensure that the photometer is not pressurized by zero air. Installation of a Tee is common. A minimum of 1 lpm excess is required.





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### Do you notice anything unusual with the slope and intercept?

			Make:	NIST					
			Model:	SRP-10					
			S/N:	10					
SESD Pro	ject #:	11-0325	Gues	t Test Status:	PASS				
Test #:		1	Guest	Known Offset:	0				
				Level 2	Slope	Intercept	R <sup>2</sup>	High O <sub>3</sub>	Lower O
		1		Averages:	1.0027	0.2780	0.9999992	507	0
				Upper Tolerance:	1.0300	3.0000			
				LowerTolerance:	0.9700	-3.0000			
								Upper	Lower
Date	Time	Date	Time					Range	Range
Start	Start	End	End	File	Slope	Intercept	R <sup>2</sup>	(ppb O <sub>3</sub> )	(ppb O <sub>3</sub> )
03/22/11	9:05 AM	03/22/11	10:21 AM	c0322001.xls	1.0009	-0.0523	0.9999996	506	-0.09
03/22/11	10:21 AM	03/22/11	11:37 AM	c0322002.xls	1.0021	0.1544	0.9999992	507	-0.05
03/22/11	11:37 AM	03/22/11	12:52 PM	c0322003.xls	1.0025	0.2643	0.9999987	507	0.14
03/22/11	12:52 PM	03/22/11	2:10 PM	c0322004.xls	1.0028	0.3155	0.9999992	507	0.09
03/22/11	2:10 PM	03/22/11	3:26 PM	c0322005.xls	1.0034	0.3515	0.9999991	507	-0.23
03/22/11	3:26 PM	03/22/11	4:42 PM	c0322006.xls	1.0034	0.4149	0.9999994	507	-0.05
03/22/11	4:42 PM	03/22/11	5:58 PM	c0322007.xls	1.0036	0.4976	0.9999995	506	-0.14
Comment	s:	Instrument	tested as fo	und.					
		No adjustm	nents made.	Positive trend notice	ed in slope a	and intercept			
				rs at time of test: Ba					



## Recent observations



 There is evidence that ambient (unfiltered) air may be entering some photometers.

Reminder: Turn off photometer pump or install particulate filters as necessary.



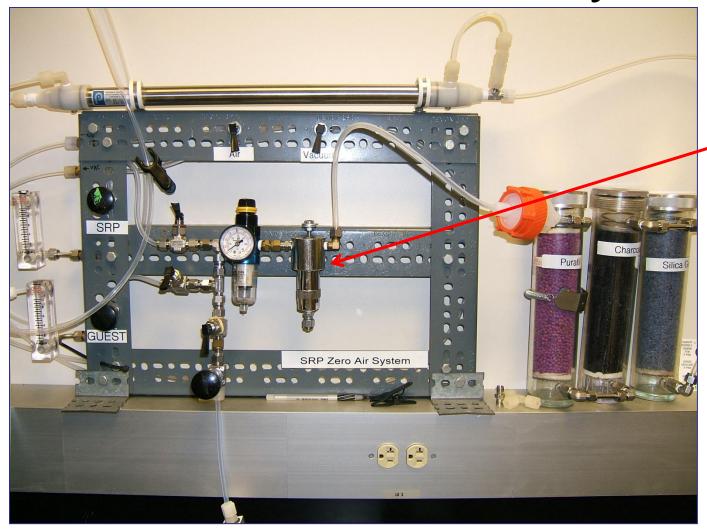
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### Cleaned photometer cells, conditioned with ozone, tried again.

		1	Make:	NIST		1	(		1
			Model:	SRP-10					
			S/N:	10					
SESD Pro	ect #:	11-0325	Gues	st Test Status:	PASS				
Test #:		2	Guest	Known Offset:	0				
				Level 2	Slope	Intercept	R <sup>2</sup>	High O <sub>3</sub>	Lower O <sub>3</sub>
				Averages:	1.0042	0.7639	0.9999992	471	0
				Upper Tolerance:	1.0300	3.0000			
				LowerTolerance:	0.9700	-3.0000			
								Upper	Lower
Date	Time	Date	Time					Range	Range
Start	Start	End	End	File	Slope	Intercept	R <sup>2</sup>	(ppb O <sub>3</sub> )	(ppb O <sub>3</sub> )
04/01/11	3:54 PM	04/01/11	5:10 PM	c0401001.xls	1.0043	0.7087	0.9999993	460	-0.10
04/01/11	5:11 PM	04/01/11	6:26 PM	c0401002.xls	1.0048	0.7304	0.9999985	471	-0.21
04/01/11	6:26 PM	04/01/11	7:47 PM	c0401003.xls	1.0041	0.7072	0.9999998	472	0.02
04/01/11	7:47 PM	04/01/11	9:05 PM	c0401004.xls	1.0037	0.8447	0.9999991	473	-0.21
04/01/11	9:05 PM	04/01/11	10:20 PM	c0401005.xls	1.0040	0.8588	0.9999992	473	-0.12
04/01/11	10:20 PM	04/01/11	11:36 PM	c0401006.xls	1.0042	0.6947	0.9999998	473	0.05
04/01/11	11:36 PM	04/02/11	12:52 AM	c0401007.xls	1.0042	0.8025	0.9999987	474	-0.19
Comment	s:	Cleaned ph	otometer ce	ells according to manu	ufacturer's i	nstructions	following dis	cussion wit	.h (person's r
Commicine									
commen		One hour of	f 1 ppm ozo	ne conditioning perfor	med prior t	o beginning	test.		



# SRP Zero Air System



A 0.01 micron membrane cartridge filter is the final step for creating zero air.



## Recent observations

- Zero drift with changes in pressure.
- The SRP zero air is typically supplied at ~25 psig / up to 4 lpm.





# Recent observations

 Marking the zero air pressure gauge is common.





## Recent observations

- Circuit boards coming loose during shipping.
- Add bubble wrap to inside, and leave me a note.
- Ship instrument to Athens, then make a day-trip to retrieve it.





# Bring two...

Our unofficial policy is that we will verify two instruments for each agency.



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# New guidance has arrived!



Transfer Standards
For Calibration of
Air Monitoring
Analyzers for Ozone

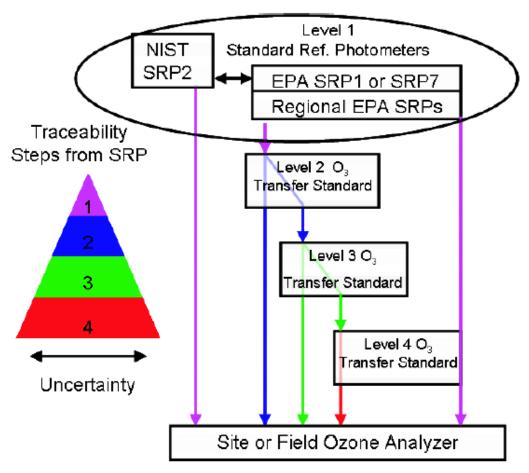
Technical Assistance Document

November, 2010

- •Replaces 1979 document
- •Removed old analytical methods for ozone
- Uses the term "verification" instead of "certification"
- •Refers to "levels" of transfer standards



### Levels of ozone transfer standards



- •Levels based on "distance in the traceability chain" from the SRP.
- •There is a separate SOP (being revised) for Level 2 verifications, using the SRP.



Tampa, Florida - 2011

## Questions??

Mike Crowe
USEPA, Region 4 SESD

crowe.mike@epa.gov

(706) 355-8630